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# CROSSBREEDING CHALLENGES AND ITS EFFECT ON DAIRY CATTLE PERFORMANCES IN AMHARA REGION, ETHIOPIA

**Addis Getu[1]✉, Tadese Guadu[2], Shewangizaw Addisu[1], Asechalew Asefa[1], Malede Birhan[1], Nibrete Mogese[3], Mersha Chanie[4], Basazenew Bogale[4], Atnaf Alebie[5], Atsedewoyne Feresebhate[5], Tegegn Fantahun[6], Tadegegne Mitiku[4]**

*Department of ([1]Animal Production and Extension, [2]Environmental and Occupational Health and Safety, [3]Veterinary Clinical Medicine, [4]Para Clinical Study, [5]Basic Science in the Faculty of Veterinary Medicine, University of Gondar), [6]Animal Science Mizan Tepi University, Ethiopia*

✉Email: Addisgetu2002@Yahoo.Com

**ABSTRACT**: At the beginning, purposive sampling techniques were conducted to select dairy potential zones with the aim of identifying dairy cattle genetic improvement trends in Amhara region which was initiated by the university of Gondar, Ethiopia. Following that north Gondar, south Gondar and west Gojam zones were selected for the study in 2016. A systematic simple random sampling method was considered to select market oriented dairy owners. Primary and secondary data was generated from owners and experts using semi structured questioner, respectively. Therefore the result indicated that the local animals have better in test and odder of their product. However, the productivity is the current challenge to afford the demand driven by the society. According to the data obtained from the interview, cross breeding is an alternative option to respond for the demand grown even if the breeding strategy was at random. According to the respondents' saying, the bench mark for the blood level of the improved genetic resource under our production system is 75:25 local to exotics than 50:50 (under dominant hetrosis) in different aspects like productivity even external body condition and appearances. Mean age at first female sexual maturity was 3.9+1.5, 2.6+0.23, 2.6+0.23, 3.14+1.5, 2.4+0.52 years with average mean age of 3.01±0.94 years and as well as first male sexual maturity was 4.2±0.28, 3.12±0.05, 2.65±0.25 and 2.10±0.11 with average mean age of 3.02±017 years in local, F1, F1x Local and F1x Exotics cattle, respectively. Whereas the blood level of exotic one is increased, the environmental interaction effect is over than the traits governed by the genotype. Disease, feed, drug, liquid nitrogen and market are the great challenge of dairy production with the weighted index value of 0.25, 0.12, 0.31, 0.20 and 0.12, respectively. Therefore, the result from this survey was indicative and brought supportive information.

**Key Words:** Cattle, Crossing, Effect, Improvement, Local, Performance, Ethiopia

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## INTRODUCTION

Ethiopia boasts the largest livestock population in Africa. The livestock sector currently contributed 13-16 % GDP and comprises about 53 million head of cattle, almost all of which are local breeds. The sector plays an important role in economic development which contributing about 12% of the Gross Domestic Product (GDP). The female stock (comprising 55% of the total cattle population) and produces an estimated 3.2 and 0.82 billion liters of milk per year in Ethiopia and in the region, respectively (FAO 2005; CSA, 2012). The average lactation milk production for the indigenous cows ranges from 494–850 liters per 1.5 years under traditional management systems which are translated into 1.54 liters per cow per day (CSA, 2008).

The above report indicated that the productive and reproductive potentials of Zebu cattle are relatively low. Therefore, crossbreeding with *B. Taurus* (which combines additive, dominance and epistatic effects of the two genotypes) is recommended to ensure better productive and reproductive performance production of the hybrids. Consequently, in Ethiopian history, domestication and the use of conventional livestock breeding techniques for genetic improvement of dairy cattle to enhance milk production of local breeds is over about six decades (Leakey, 2009). It also appears important to estimate the expected level of hetrosis for traits of economic interest in dairy cattle in order to evaluate the profitability of crossbreeding (Mauro et al., 2009). This program was launched during the invention of Ethiopia by Italy with importation of exotic dairy cattle breeds. Later on, the first livestock development project (1958-1963) created the Dairy Development Agency (DDA) that was concerned mainly with the development of commercial dairy farms in Addis Ababa (Fekadu, 1990). Following this Chilalo Agricultural



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Development Project (CADU), an integrated project established jointly by the Ethiopian and Swedish Governments, in Arsi region initiated intensive small scale dairy development in Ethiopia in 1967/68 was established (Kiwuwa et al., 1983). This was followed by the Wolaita Agricultural Development Project (WADU) that was established in 1971 and funded by the World Bank, applied the CADU program (Haile mariam, 1994). The focus of the program was on increasing the milk productivity of local breeds through crossbreeding and distribution of $F_1$ heifers to farmers (Ethiopian Agricultural Research Organization, 2001).

Crossbreeding has resulted in good improvements in production of milk especially when supplemented with adequate management levels in terms of nutrition and disease controls. In spite of, the presence of large and diverse animal genetic resources, the productivity of livestock remains low in many regions of the country (Fikre, 2007). Artificial Insemination (AI) practicing as cattle genetic improvement program is coming with little success. The most important constraints associated with were loss of structural linkage between AI Center and service giving units, absence of collaboration and regular communication between National Artificial Insemination Center (NAIC) and stakeholders, lack of breeding policy and herd recording system, inadequate resource in terms of inputs and facilities, and absence of incentives and rewards to motivate AI technicians (Desalegn, 2008). However, lack of quantified information on the overall genetic improvement and supportive academicians, other activities and impact of germoplasms interventions on the diversity of indigenous farm AnGR (animal genetic resource) of Ethiopia in general and in the region in particular is the major problem. Therefore, the extents of exotic genotypes have been diffused into the indigenous populations, significance importance on dairy genetic improvement, and its progress and the level of dilution is not independently assessed. Therefore the study was carried out with the aim of quantifying the significant importance of cattle genetic improvement practices and its challenges in Amhara region, Ethiopia

## MATERIAL AND METHODS

### Description of the Study Area

The study was conducted in three zones and 9 districts of Amhara regional state starting end of 2015 to 2018. Amhara National Regional State (ANRS) is located in the north-western part of Ethiopia (fig 8.1). Geographically, it is situated between latitude 9°–13°45'N and longitude 36°–40°30'E. It is bounded by the Afar, Benishangul, Oromiya and Tigray regions in the east, south-west, south and north, respectively, and by Sudan in the west. The total area of the region is estimated at 170,152 km$^2$, which is about one-sixth of the country's total area (Abegaz, 1995). The region ranges from 600 m a.s.l. at Metema and 4520 m a.s.l. at Ras Dashen, North Gondar, which is also Ethiopia's highest point. The wide range of altitude is a major factor in determining the temperature range of the region. Generally, lowland areas (<1500 m a.s.l.) experience hot temperatures, while highland areas (>1500 m a.s.l.) experience relatively cooler temperatures. For example, in the hot to warm sub moist agro-ecological zone, where the altitude ranges from 600 to 1400 m a.s.l., the mean annual temperature range is 21–27°C while in the cold to very cold moist zone, where the altitude ranges from 2800 to 4200 m a.s.l., the mean annual temperature varies from 7.5°C to 16°C (BoA, 1991).

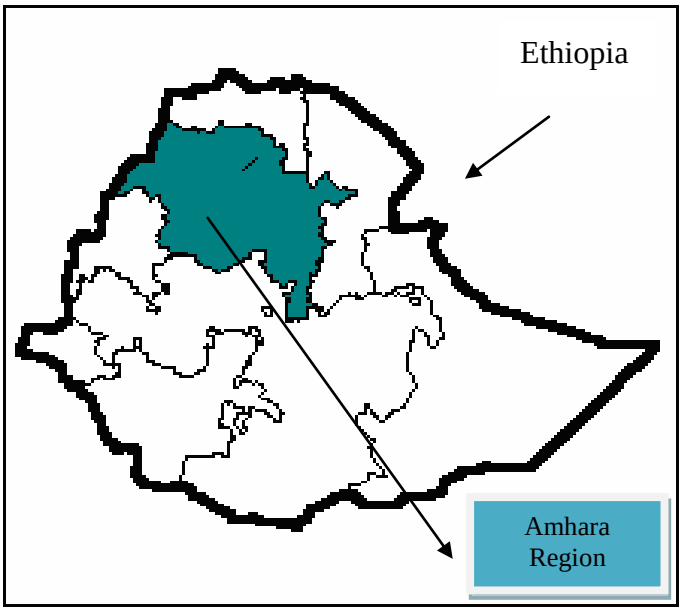


Figure 1: Map of Ethiopia showing green color where dairy improvements practices trends were evaluated



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### Sampling Framework

First exploratory field survey was conducted in different parts of the region before the main data collection work were conducted to know the potential area for dairy genetic improvement practices have been conducted earlier. Potential genetic improvement practices area that have been conducted earlier like cross breeding trend, AI status, performance, problems, genetic progresses, population diversity change and proportion were documented from the selected three zones (nine districts).

### Sampling Size and Techniques

Accordingly in the 3 representative zones a total of 9 districts and 27 PAs (3 per district) were considered. For semi-structured questionnaires n = 3456 owner respondents were randomly selected and interviewed.

### Data Types

Data from questionnaire on productive and reproductive performances like milk yield, lactation length, puberty, age at first service, age at first calving, calving interval etc ability of each blood levels dairy cattle and managements aspects such as husbandry practices, major constraints and other related activities of respondents were documented through semi-structured questionnaires in the nearest two digital techniques adopted from livestock characterization research system manual (FAO, 2011).

### Data Collection Procedures and Methods

Single rapid exploratory field observation and study area determination was carried out in the first year. Participatory rural appraisal (PRA), multi-stage and systematic simple random sampling technique, semi-structured questionnaires, trait characterizations were employed to dig up the required in formations. Therefore, purposively representative zones were selected with key informants and livestock experts based on dominant cattle crossing potential.

### Data Management

Data was managed both in hard and softcopies. Therefore errors and confused records were corrected back immediately and physically verifying to the respondents, house. All collected data was entered and managed using Microsoft Excel computer programme and run into SAS several times to test its significance.

### Statistical Technique

Data from focus group discussion was briefly summarized and synthesized and simple descriptive statistics for performance data, socio-economic characteristics and flock size was used and imported to (SAS, 2002) for windows. Tukey comparison test was used to compare sub factor means separately that was brought significant difference.

## RESULT AND DISCUSSION

### Socio-Economic Characteristics of the Respondents

The household characteristics of interviewed respondents are presented in Figure 2. About 25, 20.1, and 20% of the interviewed owners were females from north Gondar, west Gojam and south Gondar zones, respectively. While the majority of the respondents about 75% were fully involved in rural small scale mixed crop-livestock, the per urban and urban types crop-livestock production systems and used cattle as source of income for immediate expenses such as purchasing salt, coffee, clothe and animals' medicine. Most of the cows held on rural small scale farms were lactating during the study period, while higher percentages of dry cows were observed on peri urban and urban farms. Milking, processing, cleaning and selling of dairy products such as milk and butter was performed by adult males and females Most of the information was generated from males which indicated that mainly men were responsible for rearing of dairy cows. Moreover, about 22.5 % of the average interviewed farmers were illiterate while 50.7 % were read and write and 10.7% and 2.7% were literate respondents who had gone through primary first cycle (1-4) and primary second cycle (5-8), accordingly (Figure 2). Finally illiterate, read and write educational status of the interviewed farmers in the recent study was slightly similar to southern Ethiopia of 67.8 % and 18.9 % (Alemayehu, 2002). Thus, lower educational background obtained in the study area might have negative impact for technologies transfer.



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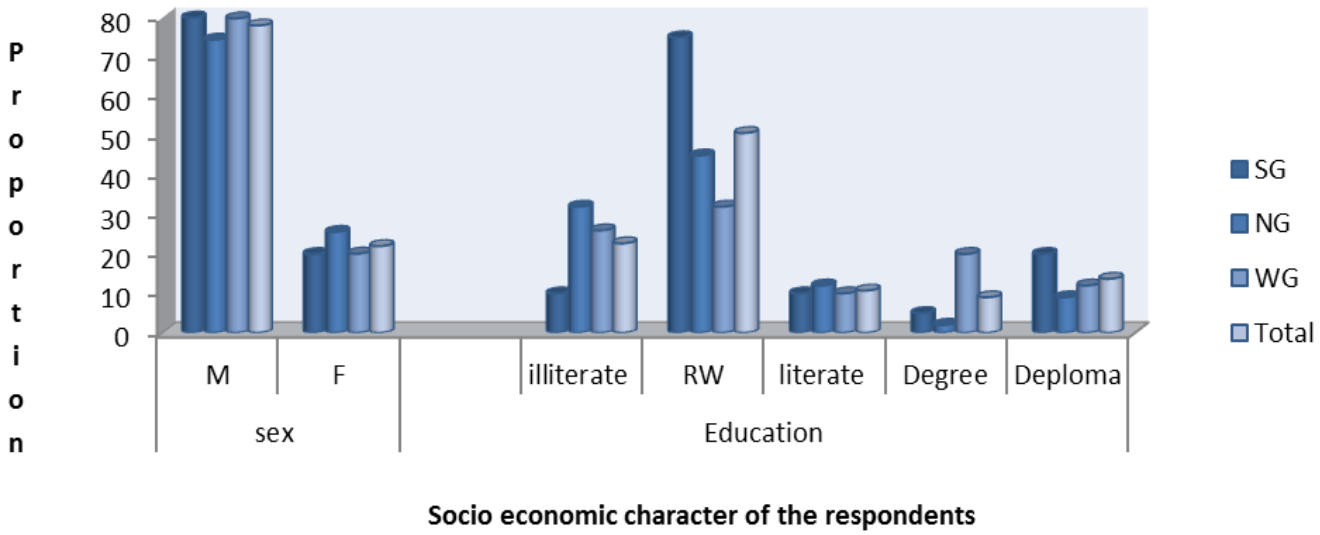


**Figure 2. Education status and sex of the respondents in the study area**
NG= north Gondar, SG= south Gondar, WG= west Gojam, RW= Read and write

**Blood Based Cattle Size and Structures**

The dominant breed structure of dairy cattle in the study area was hybrid followed by local. Indicating that overall average cattle size kept per household was 2.6±0.59, 0.60±0.26 and 3.22±0.15 for local, exotics and hybrid, respectively with a total herd size of 2.11±0.92. The same number of herd sizes observed in different districts might be because of potential based sampling technique. Finally, the respondents noted that herd size is not always the same mainly due to cattle used as source of immediate farmers' expense, occurrence of diseases and parasite. The lower proportion of the pure exotics and local one within the total herd population were observed. Thus, small numbers had given the fact that due to exotic adaptation problem and poor local performances which generate immediate expense.

*Table: 1. Cattle structures and size (Least squire mean ± SE)*

| Breed | Cow | Ox | Bull | Calves | Heifer | Total |
|---|---|---|---|---|---|---|
| Local | 2.71±0.28 | 1.90±0.22 | 1.02±0.22 | 2.10±0.77 | 0.22±0.20 | 2.6±0.59 |
| F1 | 1.11±0.51 | NA | 1.22±0.89 | 1.01±0.22 | NA | 0.69±0.31 |
| F1x Local | 0.66±0.20 | NA | NA | 0.25±0.01 | NA | 0.45±0.01 |
| F1x Exotics | 1.20±0.81 | NA | 0.95±0.12 | 0.23±0.80 | NA | 0.80±0.58 |
| Over all | 1.42±0.45 | 1.90±0.22 | 1.06±0.41 | 0.89±0.42 | 0.22±0.20 | 2.11±0.92 |

NA= not available

**Cattle Crossbreeding Trends and Its Effect**

Data from questioner indicated that the average productive and reproductive performances effect of cross breeding was characterized under semi intensive production systems conducting through semi structured questionnaires. Almost all respondents and their replacement stocks for dairy production were obtained in the form of purchased and produced from their own herd. According to the respondents' point of view good performance of hybrid could be attributed to both genetic and supplementary feeds. The present finding discovered that mean age at first female sexual maturity was 3.9+1.5, 2.6+0.23, 2.6+0.23, 3.14+1.5, 2.4+0.52 years with average mean age of 3.01±0.94 years and as well as first male sexual maturity was 4.2±0.28, 3.12±0.05, 2.65±0.25 and 2.10±0.11 with average mean age of 3.02±017 years in local, F1, F1x Local and F1x Exotics cattle, respectively. Average productive and reproductive performances and their significant difference were estimated under existing farmers' management condition (Table 2). In this result average age at first female sexual maturity was almost similar to 3.17 and 2.58 year for local and F1 heifers, respectively (Belete, 2006). This indicated that the better performance of and existence of variability in production could be an indication of the potential for genetic improvement through


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cross breeding is appreciative. In the surveyed result average mean milk production was about 6.50±0.52 liters of milk produced per day per household out of which 22 % of milk was used for consumption, 67% of milk for processing and 14 % of milk for marketing so that the marketable amount was the smallest portion of the daily production and the production objective was inline and performance was not agreed with others like Zewdu (2004) and Belete (2006) with average milk of 2.8 litter per day per cow.

**Table 2. Performance aspect of cattle in different blood levels (Lsm±SE) without the interaction effects of sites**

| Parameters | Blood Level | | | | Over All Mean |
|---|---|---|---|---|---|
| | Local | F1 | F1x Local | F1x Exotics | |
| ARLL Cattle | 12.11±0.05$^{a}$ | 9.12±0.52$^{b}$ | 10.02±0.47$^{b}$ | 8.17±0.18$^{c}$ | 9.86±0.30 |
| AAFFSM | 3.9+1.5$^{a}$ | 2.6+0.23$^{b}$ | 3.14+1.5$^{a}$ | 2.4+0.52$^{b}$ | 3.01±0.94 |
| AAFMSM | 4.2±0.28$^{a}$ | 3.12±0.05$^{b}$ | 2.65±0.25$^{bc}$ | 2.10±0.11$^{c}$ | 3.02±017 |
| Milk Yield | 2.06±0.89$^{d}$ | 7.22±0.74$^{b}$ | 5.90+0.22$^{bc}$ | 10.8+0.15$^{a}$ | 6.50±0.52 |

ARLLC = Average reproductive life of local cow, AAFMSM = age at first male sexual maturity, AAFFSM = age at first female sexual maturity, a, b, c, list square mean with different superscript within a raw are significantly different (P < 0.05).

### Marketing systems in the Study Area

Market value differences are a good indicator to evaluate the cross breeding effect on the difference blood levels of animals on the performances associated to current market prices. During data collection the communities were sold the live cattle, milk and butter from the ordinary day (Table 3). Respondents underlined that the prices are influenced by blood level of cattle, seasons and holidays. In the usual market the owners get better prices from matured male and female animals with the average prices of 28000.00, 14111.11±2.24, 20250.00±2.76, 22111.11±1.74 and 21888.89±1.74 from exotic cow, local ox, f1 cow, f1x local and f1x exotic cows, respectively. The prices obtained in this finding was significantly higher compared to blood level for matured animal resources with sub effects of blood levels up to 50% and F1 x local based on the current farmer production systems of the study area.

Market and road accessibility in particular, phenotypic nature of an animals, seasons and holydays in general play important role for the variations of prices in the study area. The present study showed that price per litter for milk and kilo gram for butter was got the same prices from mixed bloods except local products (Table 3). In the same time, due to lack of marketing access to main road and information during fasting live animal and their products prices were lower than the normal conditions. Odder of animal product and blood levels of an animal is the minimal influenced factor for the prices even if the difference is not this much significant.

**Table 3. Mean prices birr of live cattle, milk and butter in ordinary market days (Lsm±SE)**

| Blood Levels | Heard Structure | | | By Products | |
|---|---|---|---|---|---|
| | Cow | Heifer | Ox | Milk | Butter |
| Exotic | 28000.00±11 | 18000.00±0.25 | 17000.00±11 | 7.05±0.20 | 120.00±0.78 |
| Local | 4955.56±12 | 3811.11±0.11 | 14111.11±14 | 10.33±0.11 | 131.11±0.55 |
| F1 | 20250.00±21 | 15125.00±025 | 14375.00±0.50 | 7.50±0.85 | 128.75±0.71 |
| F1x Local | 22111.11±0.85 | 17000.00±12 | 15222.22±41 | 7.78±0.22 | 134.44±12 |
| F1X Exotic | 21888.89±44 | 15111.11±14 | 13888.89±0.14 | 7.78±0.85 | 131.11±0.97 |

F1 and F2 is family one and family two, respectively

### Major Constraints in dairy Production in the Study Area

Major constraints for dairy production are presented in Table 4. Among the reported constraints on the production which were prioritized by the respondents in the study area were presence of disease, feed, drug availability, lack of liquid nitrogen and marketing problem. Most respondents were frequently mentioned diseases as the first ranked dairy production constraint in all districts whereas liquid nitrogen was the third problems in districts. Market facilities including access to main road and unstable price were the bottleneck of dairy production in all study area where as poor veterinary and lack of extension services were identified as a common limitation in all districts. Constraints were not different from those reported by others in Ethiopia such as Zewdu (2004) and Belete (2006) who reported that the main constraint of dairy production system was disease and shortage of drug availabilities.



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Table 4. Rating of major constraints of dairy production in the study area

| Major Constraints | Zones | | | Weighted value |
|---|---|---|---|---|
| | SGZ | NGZ | WGZ | |
| Disease Prevalence | 0.18(4) | 0.27(2) | 0.26(2) | 0.25(2) |
| Feed Shortage | 0.11(3) | 0.10(4) | 0.13(4) | 0.12(4) |
| Drug | 0.35(1) | 0.28(1) | 0.30(1) | 0.31(1) |
| Liquid Nitrogen | 0.10(5) | 0.26(3) | 0.24(3) | 0.20(3) |
| Market Access | 0.15(2) | 0.09(5) | 0.06(5) | 0.12(4) |

NGS= north Gondar zone, SGZ= south Gondar zone, WGZ= west Gojam zone and ranks of constraints within a column bearing different numbers are different from each other. The importance of constraints was rated based attributed to productions by individual respondents; most important = 1, least important = 5

## CONCLUSIONS AND RECOMMENDATIONS

A key informant is found to be a useful individual to identify everything in the area. Exotic, local and hybrid like $F_1$, $F_1$x local and $F_2$ x exotic were characterized from the three zones like north Gondar, south Gondar and west Gojam zones. In addition to reproductive diversity of cattle, marketing price difference which could be a base to estimate the effect and regret of the performances and give the powerful evidence on the general trends of crossbreeding.

When the blood level of exotic one is increased, the environmental interaction effect is over than the traits to be governed by the genotype. Disease, feed, drug, liquid nitrogen and market access are the great challenge of dairy production with the weighted index value of 0.25, 0.12, 0.31, 0.20 and 0.12, respectively. Therefore, constraints, performance regretted point is the main focusing area in addition to monitoring and measurable data from the next round which was bring supportive information on the performance interaction effect of the blood levels with measurable traits of the animals.

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### Competing Interests

The competing interest is assured by copy right agreement and there is no computing interest in this research paper.

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